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PROFIBUS-DP technical user's manual for PWR24 module. V1.7

(Firmware v1.3 and +, Hardware v10 or v11)

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Appendix A – "PWR24 Response according to Profibus Master's Request**"**	Describes PWR24 behaviour for each Profibus master request, according to bit1 and bit2 of Order byte and Multiplex byte.

Version :	Date :	Author :	Remarks – modifications :
1.7	5.05.2002	O.L	Automation procedures.
1.6	25.01.2002	O.L	Document revisited
1.5 (Fw. 1.3)	28.11.2001	S. CHABERT	Added : New default : "SectorDefault",
1.4 (Fw. v1.2)	29.10.2001	S. CHABERT	Added : new settings - Nominal power, - Srv Voltage, - CutOut, - OverHeat. Resistance are now 2 bytes long. New Example.
1.3 (Fw. v1.1)	-	S. CHABERT	Example corrected.
1.0 (Fw. V1.1)	-	S. CHABERT	-

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OVERVIEW

The PWR power regulator from OLICORP is a PROFIBUS-DP slave which runs accordingly to the Profibus-DP specifications defined in the standards EN 50170 / DIN 19245 / Part 3. The Profibus-DP certification is pending.

On this type of networks, the MASTER DEVICES control the data communication on the bus while the SLAVES DEVICES only answer the requests from the masters.

The master may be :

- A Programmable Logical controller (PLCs)
- A PC with a Profibus-DP interface.

The OLICORP PWR module is a Profibus slave which has been tested with several masters:

- Siemens PLCs *"SIMATIC 400"*,
- Siemens PLCs *"SIMATIC 300"*,
- *SST profibus master card* (PC solution) with a windows based user-interface

Procedure to use a PWR regulator with a PLC :

The GSD file provided by OLICORP contains a standardized description of the PWR regulator, which enables the automatic detection of the PWR regulator by the master.
But, as the data transmitted by the PWR are multiplexed, it is necessary to complete this automated installation by the installation of a specific program to extract the regulation data from the datagrams.
Specific examples and tools are available for the SIEMENS's PLCs using the STEP7 language.

Procedure to use a PWR regulator with a PC :

There is no unique way to configure the communications between a PC and the Profibus Network. OLICORP has already tested a solution with a SST profibus Card. The control of the network is done through a dedicated API. OLICORP has developed several ActiveX to facilitate the use of this API.

The latest versions of the programs, GSD files, manuals, examples are available at : http://www.olicorp.net/pub

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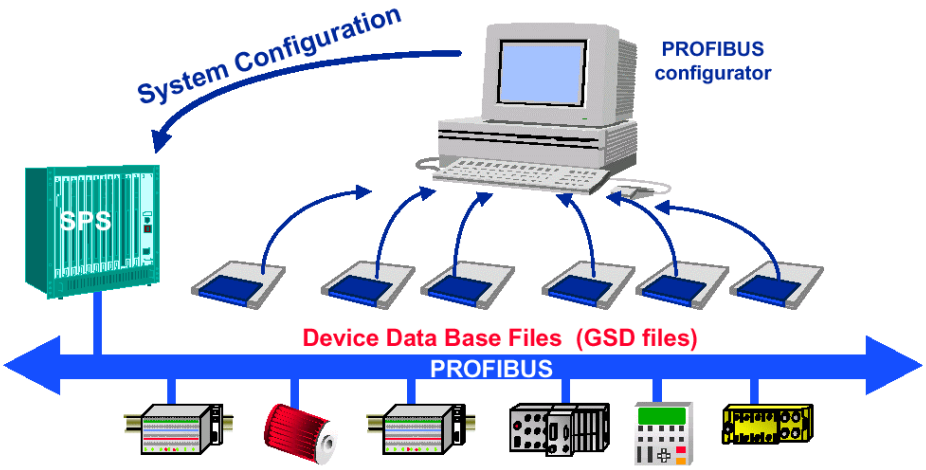

More information about PROFIBUS-DP: *http://www.profibus.com*

ORGANISATION OF THIS DOCUMENT :

(A) Installation :

- Connecting the PWR24 to the profibus network.
- Configuring the Master to detect the PWR24 (example with a SIEMENS S315 PLC)
- Controlling the PWR24 using the OL_STEP7 module provided by OLICORP
- Controlling the PWR24 using the low level STEP7 blocs SFC14 and SFC15
- Using non SIEMENS PLCs….

(B) Technical data :

- The OLICORP multiplexing protocol
- Regulation commands and procedures

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(A) INSTALLATION :

The quick mounting procedure is also described in the technical user's manual.

Connecting the hardware :

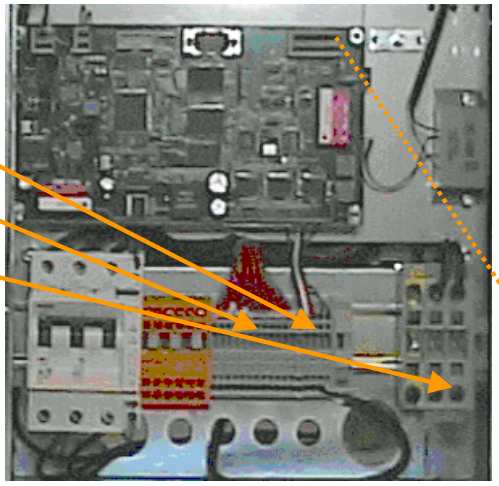
(1) Mount the PWR onto the machine and secure it with 3 M5 bolts.

(2) Open the front door, and Connect the 24 volts power supply

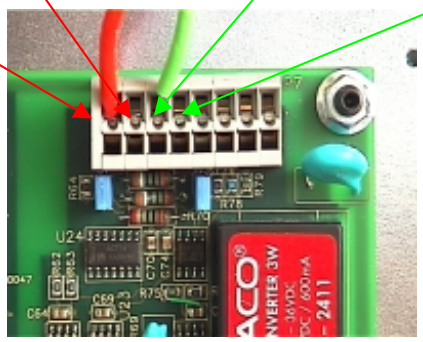
(3) connect the 12 loads to the 12 connectors at the bottom

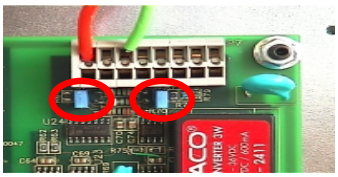
(4) Connect the industrial power supply

(5) Plug the Profibus-DP to the MPU card. Don't forget to remove the straps if you plan to chain several slaves on the profibus.

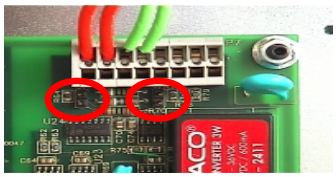


Data line B (Receive) **Data line B (Transmit)** **Data line A (Receive)** **Data line A (Transmit)**



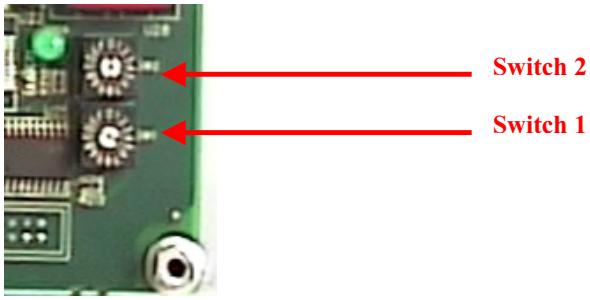


The Jumpers are set – The bus is terminated



The Jumpers are not set – The bus is not terminated

(6) Set the Profibus ID of the PWR using the two wheels on the left of the MPU



The PROFIBUS_DP address is displayed in a hexadecimal format.

PFBaddr = SW2value & SW1value (hex.)

Example:

PFBaddr = 1 & 5 = 15 (hex.)
PFBaddr = 21 (dec.)

The addresses between 4 and 122 are available for the slaves.

(7) Close the front door

MASTER CONFIGURATION WITH THE SIEMENS PLC :

The configuration is made easier by using the GSD file provided by OLICORP and available from our Web site : (www.olicorp.net/pub)

The procedure to load the GSD may depends on the PLC type.
With the SIEMENS PLCs, one should load the GSD from the STEP7 programming interface by simply loading a new device and pointing to the gsd file when required.

Loading the GSD will affect the following parameters :

- Name of the slave : Set to IRPC12-60
- Profibus Identification : 0x0594
- Length of users datagrams : 5 bytes
- Length of data exchange datagrams : 6 bytes

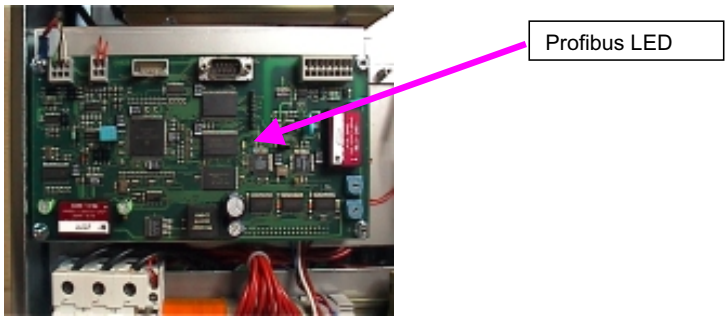
The name of the GSD file MUST be olic0594.gsd to work properly. When downloading the latest version of the GSD from our site, please rename the file to olic0594.gsd

GSD CONTENT : olic0594.gsd

```
#Profibus_DP

GSD_Revision = 1
Vendor_Name = "OLICORP technologies Genève"
Model_Name = "IRPC12-60"
Revision = "1.3"
Ident_Number = 0x0594
Protocol_Ident = 0
Station_Type = 0
FMS_supp = 0
Hardware_Release="V1.1"
Software_Release = "V1.3"
9.6_supp = 1
19.2_supp = 1
31.25_supp = 1
45.45_supp = 1
93.75_supp = 1
187.5_supp = 1
500_supp = 1
1.5M_supp = 1
3M_supp = 1
6M_supp = 1
12M_supp = 1
MaxTsdr_9.6 = 60
MaxTsdr_19.2 = 60
MaxTsdr_31.25 = 60
MaxTsdr_45.45 = 60
MaxTsdr_93.75 = 60
MaxTsdr_187.5 = 60
MaxTsdr_500 = 100
MaxTsdr_1.5M = 150
MaxTsdr_3M = 250
MaxTsdr_6M = 450
MaxTsdr_12M = 800
Redundancy = 0
Repeater_Ctrl_Sig = 2
24V_Pins = 0
Implementation_Type="SPC3"
;Bitmap_Device = ?
;Bitmap_Diag = ?
;Bitmap_SF = ?


Freeze_Mode_supp=0
Sync_Mode_supp=0
Auto_Baud_supp = 1
Set_Slave_Add_supp = 0
User_Prm_Data_Len=0x05
User_Prm_Data = 0x00,0x00,0x00,0x00,0x00
Min_Slave_Intervall=1
Modular_Station=0

Module="Chauffe" 0x95, 0xA5
0
EndModule

Fail_Safe=0
Max_Diag_Data_Len=25
Slave_Family = 5@OLICORP
```

At this point the Profibus-DP connexion between the Master and the PWR module should run correctly.

The Profibus LED on the MPU card gives the status of the connexion.
If it is green the connexion is ready. If it is off; then the connexion doesn't work.



At this point the Lower layers of the communication are running. It means that the datagrams are correctly exchanged between the master and the slave.

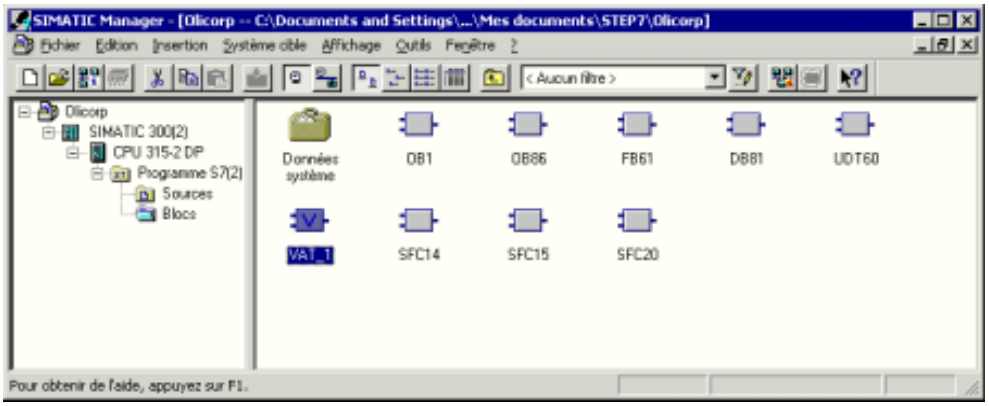
USING THE OL_STEP7 MODULE TO CONTROL THE PWR24. :

To start the dialog at the application level one has first to configure the PLC to interpret the data exchanged with the PWR regulator.
The OL_STEP7 module may be used to simplify this task.

The file http://www.olicorp.net/pub/chauffe/softs/step7_sample_mailbox_1_2.zip, contains a sample STEP7 project.
The module may be included directly in your own STEP7 project.

Basic structure of the STEP7 project.

The OL_STEP7 is organized around a few STEP7 blocs :
- DB81
- FB61
- SFC14
- SFC15



The regulation parameters are stored in the DB81 data block. In this example we consider only one PWR24 module. If we want to use more PWR24 modules on the profibus network, it will then be necessary to add some additional data blocks to store the configuration of each PWR24.

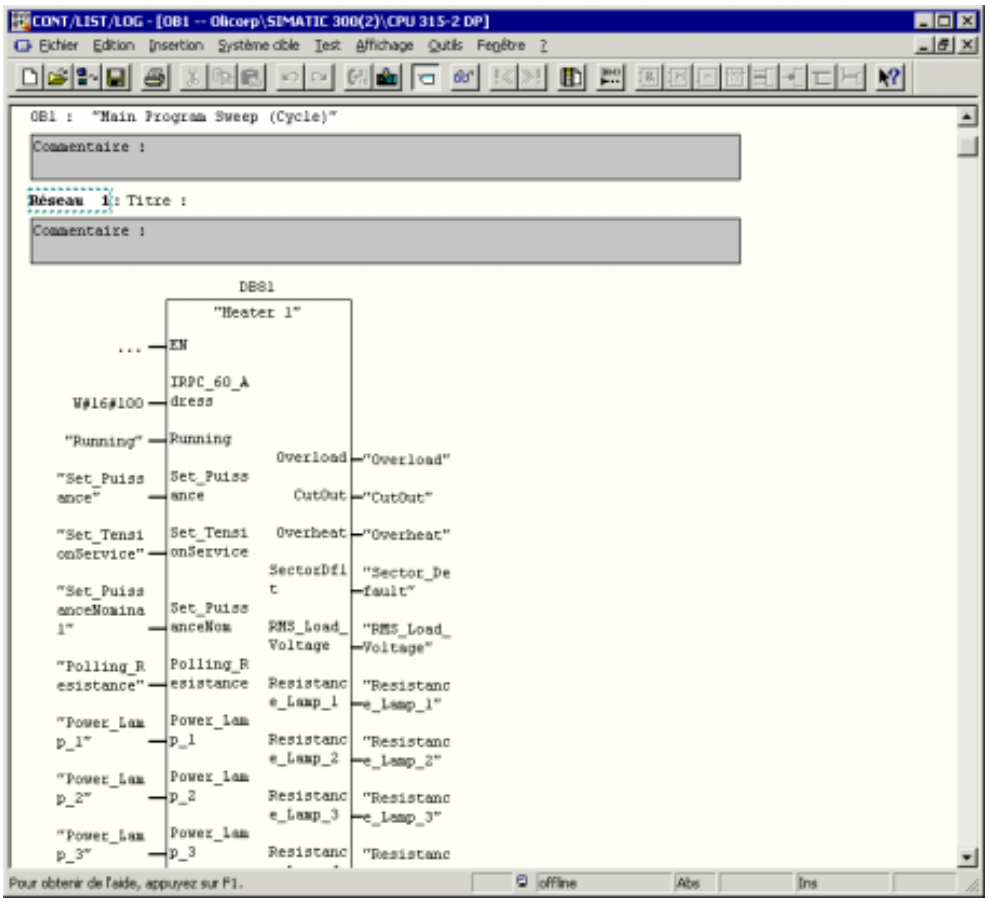
The FB61 function block is the core program that makes calls to the SFC14 and SFC15 modules. SFC14 and SFC15 modules include low level functions to control profibus communications.
The FB61 does automatically MUX and DEMUX actions when necessary.

The call to the FB61 is done in the OB1 organization block

Symbols :

```
126,
126,
126,
126,BLKMOV                    SFC    20   SFC    20 Copy Variables
126,CutOut                    M       1.1 BOOL
126,CYCL_EXC                  OB      1   OB      1 Cycle Execution
126,DB Multiplex IRPC12 60    DB      61    UDT     60 Data Block for the Data Multiplex of IRPC
12-60
126,DPRD_DAT                  SFC    14   SFC    14 Read Consistent Data of a Standard DP Slave
126,DPWR_DAT                  SFC    15   SFC    15 Write Consistent Data to a Standard DP Slave
126,Heater 1                  FB     61   FB     61 Interface with ASIC Olicorp
126,Overheat                  M       1.2 BOOL
126,Overload                  M       1.0 BOOL
126,Polling_Default           M       0.4 BOOL
126,Polling_Resistance        M       0.3 BOOL
126,Power_Lamp_1              MW     110   WORD
126,Power_Lamp_10             MW     200   WORD
126,Power_Lamp_11             MW     210   WORD
126,Power_Lamp_12             MW     220   WORD
126,Power_Lamp_2              MW     120   WORD
126,Power_Lamp_3              MW     130   WORD
126,Power_Lamp_4              MW     140   WORD
126,Power_Lamp_5              MW     150   WORD
126,Power_Lamp_6              MW     160   WORD
126,Power_Lamp_7              MW     170   WORD
126,Power_Lamp_8              MW     180   WORD
126,Power_Lamp_9              MW     190   WORD
126,RACK_FLT                  OB      86   OB     86 Loss of Rack Fault
126,Resistance_Lamp_1         MW     112   WORD
126,Resistance_Lamp_10        MW     202   WORD
126,Resistance_Lamp_11        MW     212   WORD
126,Resistance_Lamp_12        MW     222   WORD
126,Resistance_Lamp_2         MW     122   WORD
126,Resistance_Lamp_3         MW     132   WORD
126,Resistance_Lamp_4         MW     142   WORD
126,Resistance_Lamp_5         MW     152   WORD
126,Resistance_Lamp_6         MW     162   WORD
126,Resistance_Lamp_7         MW     172   WORD
126,Resistance_Lamp_8         MW     182   WORD
126,Resistance_Lamp_9         MW     192   WORD
126,RMS_Load_Voltage          MD      80   DWORD
126,Running                   M       2.0 BOOL
126,Sector_Default            M       1.3 BOOL
126,Set_Puissance             M       0.0 BOOL
126,Set_PuissanceNominal      M       0.2 BOOL
126,Set_TensionService        M       0.1 BOOL
126,VAT_1                     VAT     1
```

Call to the FB61 (Heater 1) in the OB1 :



In this example, we have directly included the call to the FB61 in the OB1. The call to FB61 is done a each cycle. We suggest to control the call to FB61 to avoid unnecessary traffic on the fieldbus.

Parameters used in the DB81 and FB61 :

Variable		Type	Signification
Run enabled	R/W	Boolean	Start/Stop the regulation
Set Power	W	Boolean	Specify that the transmitted data will serve to set the required power to the different loads.
Set nominal power	W	Boolean	Specify that the transmitted data will serve to define the nominal power of the different loads
Set voltage	W	Boolean	Specify that the transmitted data will serve to define the nominal voltage for the different loads
Read Resistance enabled	W	Boolean	Start/Stop the pooling of the resistances measured by the PWR
Alarm Overload	R	Boolean	True if the system has measured a current higher than 160 A on the input. This alarm stops the regulation.
Alarm Overheat	R	Boolean	True is the temperature inside the PWR cabinet is higher than 60°c.
Alarm Cut-out	R	Boolean	True if the breaker inside the cabinet is opened
Alarm Sector Default	R	Boolean	True if the supply voltage is outside the range 200 VAC-550 VAC.
Sector Voltage RMS	R	Int	Measured voltage on the power supply (V)
L1 Resistance	R	Int	Resistance measured on the Load 1. (MilliOhms) 0xffff the load is broken 0 Short circuit
L2 Resistance	R	Int	Resistance measured on the Load 2. (MilliOhms) 0xffff the load is broken 0 Short circuit
L3 Resistance	R	Int	Resistance measured on the Load 3. (MilliOhms) 0xffff the load is broken 0 Short circuit
…			
L12 Resistance	R	int	Resistance measured on the Load 12. (MilliOhms) 0xffff the load is broken 0 Short circuit
L1 Nominal Power	W Available Only if the Regulation is OFF	Int	Load 1 nominal power (Watts). To be set before starting the regulation.
L2 Nominal Power	W Available Only if the Regulation is OFF	Int	Load 2 nominal power (Watts). To be set before starting the regulation.

….		…	….
L12 Nominal Power	W Available Only if the Regulation is OFF	Int	Load 12 nominal power (Watts). To be set before starting the regulation.
L1 Service Voltage	W Available Only if the Regulation is OFF	Int	Service voltage for load 1 (Volts)
L2 Service Voltage	W Available Only if the Regulation is OFF	Int	Service voltage for load 2 (Volts)
…			
L12 Service Voltage	W Available Only if the Regulation is OFF	Int	Service voltage for load 12 (Volts)
L1 Power	R/W	Int	This parameter is used to set the power required on the load 1. The PWR regulator return the power effectively applied to the load. (Watts)
L2 Power	R/W	Int	
….			
L12 Power	R/W	Int	

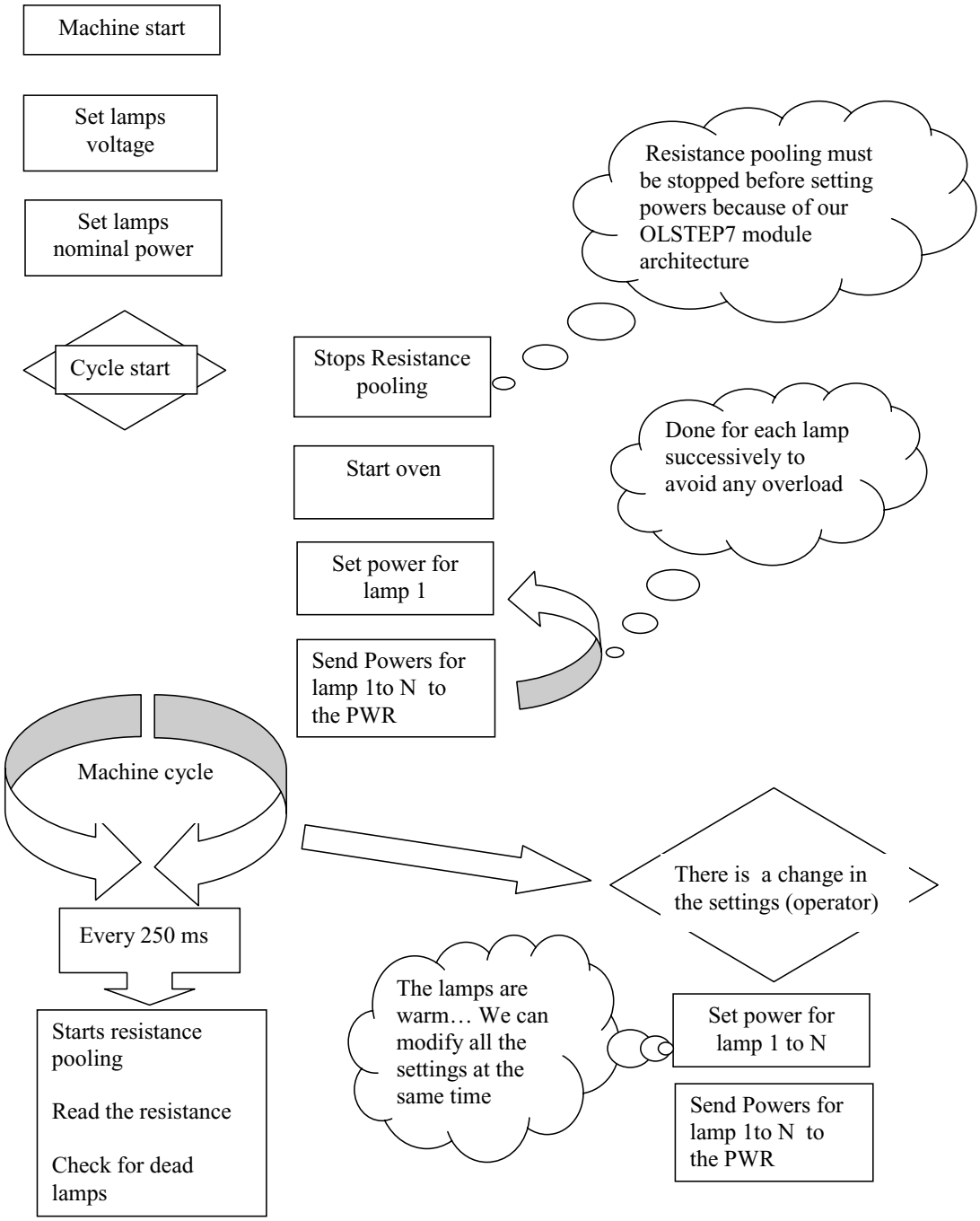
Note :

The PWR module uses the "Nominal Power" and the "Service Voltage" to calculate a theoretical resistance for each lamp:

$$R_{dft} = \frac{(U_{srv})^2}{P_{nom}}$$

This theoretical resistance is used when the regulation is started.

Programming the PLC to control efficiently the PWR module :


Machine start
Set lamps voltage
Set lamps nominal power
Cycle start
Stops Resistance pooling
Resistance pooling must be stopped before setting powers because of our OLSTEP7 module architecture
Start oven
Set power for lamp 1
Done for each lamp successively to avoid any overload
Send Powers for lamp 1to N to the PWR
Machine cycle
Every 250 ms
Starts resistance pooling
Read the resistance
Check for dead lamps
There is a change in the settings (operator)
The lamps are warm… We can modify all the settings at the same time
Set power for lamp 1 to N
Send Powers for lamp 1to N to the PWR

Examples :

The following table describes the different steps to configure and start the PWR regulator with the OL_STEP7 module :

Variable	Power On	Service voltage	Set service voltage	Stop set service voltage	Nominal power	Set nominal power	Stop set nominal power	Stop read resistance	Power Load 1	Set power	Stop set power	Start regulation	Power load 2	Set power	Stop Set power	Power Load 1 -12	Set power	Stop set power	Pooling Resistance
Run enabled	0																		
Set Power	0																		
Set nominal power	0																		
Set voltage	0																		
Read Resistance enabled	1																		
Alarm Overload	0																		
Alarm Overheat	0																		
Alarm Cut-out	0																		
Alarm Sector Default	0																		
Sector Voltage RMS	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	396
L1 Resistance	0																		8007
L2 Resistance	0																		7956
L3 Resistance	0																		8012

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Variable	Power On	Service voltage	Set service voltage	Stop set service	Nominal power	Set nominal power	Stop set nominal	Stop read resistance	Power Load 1	Set power	Stop set power	Start regulation	Power load 2	Set power	Stop Set power	Power Load 1 -12	Set power	Stop set power	Pooling Resistance
…																			
L12 Resistance	0																		7650
L1 Nominal Power					1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
L2 Nominal Power					2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
….																			
L12 Nominal Power					1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
L1 Service Voltage		400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400
L2 Service Voltage		400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400
…																			
L12 Service Voltage		400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400
L1 Power									967	967	356	512	967	967	967	967	967	967	967
L2 Power												1212	1212	350	502	950	1212	1212	1212
….																			
L12 Power																	1500	1500	300

SUMMARY :

Basic steps to start the regulation :

- Set the Service voltage for every load.
- Set the nominal power for every load .
- Set the desired power for each load (when lamps are cold it is better to start them sequentially to avoid any over load)
- Start the regulation.
- Set the power for other lamps or modify the desired power.

ATTENTION : The service voltage and the nominal power MUST BE SET for every channels, even if no load is connected……..

ATTENTION : when a desired power is set. It may take some time for the lamp to reach effectively this power, especially when it is cold. In the meanwhile the PWR regulator informs the PLC of the effective power.

PROGRAM CONTROL USING LOW LEVEL FUNCTIONS :

The following information is useful for whom may plan to implement protocol level communications between the slave and the master. We do recommend using the ready to use STEP7 module provided by OLICORP to avoid a complex programmatic phase.

This section is useful for whom may use non-SIEMENS PLCs….

SIEMENS PLCs and STEP7 procedures :

It is possible to work with the standard SFC14 and SFC15 STEP7 modules to mux/demux the profibus datagrams.

The http://www.olicorp.net/pub/chauffe/softs/step7_sample_sfc1415_1_0.zip sample shows how to develop such a program.
The file http://www.olicorp.net/pub/chauffe/docs/fb61.pdf contains the listing of the block which is used to call the SFC145 anf SFC15 to mux and demux the data in the OL_STEP7 module.

SIEMENS PLC

NON-SIEMENS PLCs :

ALLEN BRADLEY SLC500 WITH SST Profibus module.

When using non siemens PLCs, it is necessary to write a program that will interpret the data sent to and received from the PWR24.

- **Datagrams :**

  For a better efficiency, the data exchanged between the PWR module and the master are based on a specific format and are multiplexed.

  The Datagram is based on 6 bytes transmitted *'from'* or *'to'* the slave.

Byte#1	Byte#2	Byte#3	Byte#4	Byte#5	Byte#6
Command	**Multiplex**	**Data1**	**Data2**	**Data3**	**Data4**

- **Bytes :**

  Command: (byte #1).

When read by the master, this byte contains the current state of the PWR module.
When sent by the master, it tells the PWR regulator to switch into the different modes.

Command	EFFECTS
1 10	It operates in three modes: "*Set-New-Settings*", "*Request-Applied-Settings*" and "*Request-Expected-Settings"*. 00 = **Set-New-Settings** 10 = **Request-Applied-Settings** (=polling) (The PWR module will send back information about its current status, depending on which information is requested – see Mux Byte) 11 = **Request-Expected-Values** (The PWR module will send back information about its current settings, depending on which information is requested – see Mux Byte) *Please, refer to "Appendix A" for more details.*
100	*Reserved.*
1000 *(Read-only for master)*	1 = **Overload** 0 = **Normal state**.
10000	1 = **Running** (oven is ON), 0 = **Stopped** (oven is OFF).
100000	1 = **CutOut**

(Read-only for master)	0 = **Normal state.**
1000000 *(Read-only for master)*	1 = **OverHeat** 0 = **Normal State.**
10000000 (Read-only for master)	1 = **SectorDefault** 0 = **Normal State.**

Mode *"Set-New-Settings":* (Command bits1-2 = 0-0)

- The master sends the settings to the PWR module.
- The slave processes the request and stores the settings in its memory.
- The slave sends a datagram to the master containing the targeted settings to confirm the operation.

Mode *"Request-Applied-Settings":* (Command bits1-2 = 1-0)

- The master sends a datagram to the PWR module. This datagram is 6 bytes long but the multiplex byte is the only one which is processed.
- The slave processes the multiplex byte.
- The slave sends its current status to the master accordingly to the type of data requested (multiplex byte).

Mode *"Request-Expected-Settings":* (Command bits1-2 = 1-1)

- The master sends a datagram to the PWR module. This datagram is 6 bytes long but the multiplex byte is the only one which is processed.
- The slave processes the multiplex byte.
- The slave sends its current settings to the master accordingly to the type of data requested (multiplex byte).

Multiplex: (byte #2).

This control byte defines the role of the last four bytes (Data#1 trough Data#4) accordingly to the following table :

Multiplex	Data #1	Data #2	Data #3	Data #4
1	Power lamp #1		Power lamp #2	
2	Power lamp #3		Power lamp #4	
3	Power lamp #5		Power lamp #6	
4	Power lamp #7		Power lamp #8	
5	Power lamp #9		Power lamp #10	
6	Power lamp #11		Power lamp #12	
7	*Reserved.*		*Reserved*	
8	*Reserved.*		*Reserved*	
9	*Reserved.*		*Reserved*	
10	RMS load Voltage (relative value).			
11	Resistance lamp #1		Resistance lamp #2	
12	Resistance lamp #3		Resistance lamp #4	
13	Resistance lamp #5		Resistance lamp #6	
14	Resistance lamp #7		Resistance lamp #8	
15	Resistance lamp #9		Resistance lamp #10	
16	Resistance lamp #11		Resistance lamp #12	
17	SrvVoltage lamp #1		SrvVoltage lamp #2	
18	SrvVoltage lamp #3		SrvVoltage lamp #4	
19	SrvVoltage lamp #5		SrvVoltage lamp #6	
20	SrvVoltage lamp #7		SrvVoltage lamp #8	

21	SrvVoltage lamp #9	SrvVoltage lamp #10
22	SrvVoltage lamp #11	SrvVoltage lamp #12
23	Nominal Power lamp #1	Nominal Power lamp #2
24	Nominal Power lamp #3	Nominal Power lamp #4
25	Nominal Power lamp #5	Nominal Power lamp #6
26	Nominal Power lamp #7	Nominal Power lamp #8
27	Nominal Power lamp #9	Nominal Power lamp #10
28	Nominal Power lamp #11	Nominal Power lamp #12

How to set Data1, Data2, Data3 and Data4 ?

Data 1, Data 2 Lamp N
Data 3, Data 4 Lamp N+1

The most significant byte is on the left :
Lamp N = 4000 W
4000 = 00001111 10100000
Then :
Data1 = 00001111 = 15
Data2 = 10100000 = 160

Notes:

- The power is a *short* (2 bytes) in Watts.
- The resistance is a *short* (2 bytes) in $\frac{1}{100}$ Ohms.
- The "RMS load Voltage" is a relative value of the real RMS load voltage. To get the correct value it is necessary to calculate it using :

$$Vrms = \sqrt{\frac{RValue * MMVolts^2}{ADCFullScale^2}}$$

With:

Vrms: Real RMS load Voltage,
RValue: Value Read from PWR module.

'MMVolts' and 'ADCFullScale' are two constant that depend of the hardware implementation of the PWR module. They are printed on the internal side of the cabinet's front door.

Hardware v10 and v11 :
MMVolts = 817
ADCFullSclae = 0x4000(hex.) = 16384(dec.)

Example:

The following example shows how to configure and start the regulation by sending datagrams to the PWR regulator.

Overview:

1) **Set Nominal Power** for each lamp, using "*Set-New-Settings*" mode,
2) **Set Service Voltage** for each lamp, using "*Set-New-Settings*" mode,
3) **Set Default Power** for each lamp, using "*Set-New-Settings*" mode
   (PWR module responds with power that it will try to reach),
4) **Start regulation**
5) Settings-Polling during regulation
   a. **Check for defaults,**
   b. **Read Applied Power** for each lamp, using "*Request-Applied-Settings*" mode
   c. **Read Calculated Resistance** for each lamp, using "*Request-Applied-Settings*" mode
   d. **Read Calculated Vrms**, using "*Request-Applied-Settings*" mode
6) **Stop regulation**

Set nominal power:

Action on Master side	Datagram exchanged (hexadecimal display)	Action on PWR module side
The Master sets a Nominal power of **4000W for lamp #1,** and **4000W for lamp #2.**	0 17 0F A0 0F A0	

```
Byte1 = 00000000                                          COMMAND BYTE
        |||||  ||
        |||||  ||
         |||||  LL-> 00: Mode Set-New-Settings.
         |||||
         ||||L-----> 0: No sense from Master (Overload).
         |||L------> 0: Oven OFF (Oven will be started later).
         ||L-------> 0: No sense from Master (CutOut).
         |L--------> 0: No sense from Master (OverHeat).
         L---------> 0: No sense from Master (SectorDefault).


Byte2 = 17(hex.) = 23(dec.)                               MUX BYTE
    ----------> Byte3 and Byte4 is a new nom. power for lamp #1
    ----------> Byte5 and Byte6 is a new nom. power for lamp #2

Byte3 & Byte4 = 0F & A0 (hex.)                            SEETINGS LAMP N
              = 1111 & 10100000 (bin.)
                 00001111 10100000 = 4000(dec.) (Motorola).

Byte5 & Byte6 = 0F & A0 (hex.)                            SETTINGS  LAMP N+1
              = 1111 & 10100000 (binary)
                 00001111 10100000 = 4000(dec.) (Motorola).
```

		The PWR module sets the nominal powers for lamp 1 and 2: **Lamp #1: 4000W,** **Lamp #2: 4000W.**
	0 17 0F A0 0F A0	The PWR module acknowledges the values to the master.
Master sets a nominal power of **500W for lamp #3,** and **4000W for lamp #4.**	0 18 01 F4 0F A0	
		The PWR module sets the nominal powers for lamp 3 and 4: **Lamp #3: 500W,** **Lamp #4: 4000W.**
	0 18 01 F4 0F A0	PWR module acknowledges the values to the master.

This exchange can be repeated for the whole set of lamps by changing the MULTIPLEX code.

Set service Voltages : The commande byte is set to

The Master sets a service voltage of **400V for lamp #1,** and **400V for lamp #2.**	0 11 01 90 01 90	
		The PWR module sets the service voltages for lamp 1 and 2: **Lamp #1: 400V,** **Lamp #2: 400V.**
	0 11 01 90 01 90	PWR module acknowledges the values to the master.

Set default powers:

Master sets a power of **600W for lamp #1,** and **1000W for lamp #2.**	0 01 02 58 03 E8	

```
Byte1 = 00000000                                        COMMAND
        |||||  ||
        |||||  ||
         |||||  └└-> 00: Mode Set-New-Settings.
         |||||
         ||||└-----> 0: No sense from Master (Overload).
         |||└------> 0: Oven OFF (Oven will be start later).
         ||└-------> 0: No sense from Master (CutOut).
         |└--------> 0: No sense from Master (OverHeat).
         └---------> 0: No sense from Master (SectorDefault
```

```
Byte2 = 1 (hex.)                                        MUX
        ---------> Byte3 and Byte4 is a new power for lamp #1
        ---------> Byte5 and Byte6 is a new power for lamp #2

Byte3 & Byte4 = 02 & 58 (hex.)                          SETTINGS N
              = 10 & 01011000 (bin.)
            00000010 01011000 = 600 (dec.) (Motorola).

Byte5 & Byte6 = 03 & E8 (hex.)                          SETTINGS N+1
              = 11 & 11101000 (bin.)
                00000011 11101000 = 1000 (dec.) (Motorola).
```

		PWR module sets the powers for lamp 1 and 2: **Lamp #1: 600W,** **Lamp #2: 1000W.**
	0 01 02 58 03 E8	PWR module acknowledges the values to the master.
Master sets a power of **1000W for lamp #3,** and **1000W for lamp #4.**	0 02 03 E8 03 E8	
		PWR module sets the power for lamp 3 to 500W (because NomPower for lamp3 is 500W): **Lamp #3: 500W,** **Lamp #4: 1000W.**
	0 02 01 F4 03 E8	PWR module acknowledges the values to the master, with the values that it will try to reach.

…
Master sets a power for each lamp between #5 and #10
…

- **Start regulation:**

Master sets a power of **1000W for lamp #11,** and **5000W for lamp #12** and **starts oven**.	10 06 03 E8 13 88	

```
Byte1 = 00010000
        |||||  ||
        |||||  ||
         |||||  LL-> 00: Mode Set-New-Settings.          COMMAND
         |||||
         ||||└-----> 0: No sense from Master (Overload).
         |||└------> 0: Oven ON (PWR module will start the oven).
         ||└-------> 0: No sense from Master (CutOut).
         |└--------> 0: No sense from Master (OverHeat).
         └---------> 0: No sense from Master (SectorDefault).
```

		PWR module sets the power for lamp 11 : **Lamp #11: 1000W,** And corrects the power for lamp 12 (regards to nom. power set to 4000W) :

		Lamp #12: 4000W.
	10 06 03 E8 0F A0	PWR module acknowledges the values to the master, and starts oven

```
Byte1 = 00010011                                          COMMAND
        |||||  ||
        |||||  ||
         |||||  LL-> 11: PWR24 responds with values that it will
         |||||           try to reach.
         ||||L----> 0: No Overload.
         |||L-----> 1: Oven ON (regulation is started).
         ||L------> 0: No CutOut.
         |L-------> 0: No OverHeat.
         L--------> 0: No SectorDefault.

Byte5 & Byte6 = 0F & A0 (hex.)                          SETTINGS N+1
              = 10100000 & 00001111 (bin.)
                10100000 00001111 = 4000 (dec.) (Motorola).
```

Oven is now eating-up; it will be functional in few seconds.
Power during eating-up phase and resistances calculated by PWR module can be monitored during the process.

- **Read applied powers:**

Action on Master side	Datagram exchanged (hexadecimal display)	Action on PWR module side
Master **requests** powers applied on **lamp#1 and lamp#2**.	12 01 XX XX XX XX	

```
Byte1 = 00010010                                          COMMAND
        |||||  ||
        |||||  ||
         |||||  LL-> 10: Mode Request-Applied-Values (polling)
         |||||
         ||||L----> 0: (No sense from Master).
         |||L-----> 0: Oven ON (Not used by PWR module).
         ||L------> 0: (No sense from Master).
         |L-------> 0: (No sense from Master).
         L--------> 0: (No sense from Master).

Byte2 = 01 (hex.)                                         MUX
        ---------> Master is requesting applied power for
                   lamp#1 and lamp#2.

Byte3, Byte4, Byte5 and Byte6:
         ---------> Not used.
```

	12 01 02 58 03 09	PWR **responds** with the powers currently applied on **lamp#1 and lamp#2**.

```
Byte1 = 00010010                                          COMMAND
        |||||  ||
        |||||  ||
         |||||  LL-> 10: PWR module responds with currently
         |||||           applied values (Request-applied-Values).
         ||||L-----> 0: No Overload.
         |||L------> 0: Oven ON.
         ||L-------> 0: No CutOut.
         |L--------> 0: No OverHeat.
         L---------> 0: No Sector default.

Byte2 = 01 (hex.)                                         MUX
        ---------> PWR module is responding applied power for
                   lamp#1 and lamp#2.

Byte3 & Byte4 = 02 & 58 (hex.)                            SETTINGS N
              = 10 & 01011000 (bin.)
             00000010 01011000 = 600 (dec.) (Motorola).
Lamp#1 has reached the requested power.

Byte5 & Byte6 = 03 & 09 (hex.)                            SETTINGS N+1
              = 11 & 1001 (bin.)
                00000011 00001001 = 777 (dec.) (Motorola).
Lamp#2 has not yet reached the requested power (1000W).
```

Master **requests** powers applied on **lamp#3 and lamp#4**.	12 02 XX XX XX XX	
	12 02 03 09 03 09	PWR **responds** with the power currently applied on **lamp#3 and lamp#4**.

…
Master requests power for each lamp between #5 and #10

- **Read the measured resistances:**

Master **requests** resistances for **lamp#1 and lamp#2.**	12 0B XX XX XX XX	

```
Byte2 = 0B (hex.)                                         MUX
        ---------> Master is requesting resistance for lamp#1
                   and lamp#2.

Byte3, Byte4, Byte5 and Byte6:
         ---------> Not used.
```

	12 0B 25 48 25 51	PWR **responds** with the resistance read for **lamp#1 and lamp#2.**

```
Byte2 = 11                                                MUX
        ---------> PWR module is responding resistance for
                   lamp#1 and lamp#2.
```

```
Byte3 & Byte4 = 25 & 48 (hex.)                          SETTINGS N
              = 100101 & 1001000 (bin.)
                00100101 01001000
              = 9544 (dec.) (Motorola).
               = 95,44 Ω.

Byte5 & Byte6 = 25 & 51 (hex.)                          SETTINGS N+1
              = 100101 & 1010001 (bin.)
                00100101 01010001
              = 9553 (dec.) (Motorola).
               = 95,53 Ω.
```

Master **requests** resistance for **lamp#3 and lamp#4**.	12 0C XX XX XX XX	
	12 0C 25 67 00 00	There is a **short circuit** on lamp#4, PWR **responds** with resistance = 0Ω.

```
Byte2 = 0C                                              MUX
        ---------> PWR module is responding resistance for
                      lamp#3 and lamp#4.

Byte5 & Byte6 = 0 & 0 (dec.)                            SETTINGS
              = 0 & 0(bin.)
                00000000 00000000
              = 0 (dec.) (Motorola).
               = short circuit.
```

Master **requests** resistance read for **lamp#5 and lamp#6.**	12 0D XX XX XX XX	
	12 0D 26 08 FF FF	lamp#6 is **dead**, PWR **responds** with resistance = 0xffff = 655,35Ω

```
Byte5 & Byte6 = FF & FF (dec.)
              = 11111111 & 11111111 (bin.)
              = 65535 (dec.) (Motorola).
               = lamp is dead.
```

- **Read the measured Vrms:**

Master **requests** value to calculate **RMS load voltage**.	12 0A XX XX XX XX	
	12 0A 03 D0 27 FD	PWR module response.

```
Byte3 & Byte4 & Byte5 & Byte6 = 03 & D0 & 27 & FD (hex.)
              = 00000011 11010000 00100111 11111101
              = 6397 3373 (dec.) (Motorola).
```

$$Vrms = \sqrt{\frac{63973373 * 816^2}{16384^2}}$$

$$Vrms = 398.35\ V$$

USING A PC TO CONTROL THE PWR24

See PWR24COM and PWR24pfb docs.

Appendix A

"PWR24 answer according to Profibus Master's request"

Data Type	Request from Profibus Master	PWR24 Response
Power *(Mx : 1-6)* *(dec.)*	***SET*** – Master sets new powers,	***EXP*** – PWR24 responds with powers that it will try to reach,
	APP – Master requests currently applied power,	***APP*** – PWR24 responds with powers currently applied,
	EXP – Master requests the power that PWR module tries to reach.	***EXP*** – PWR24 Responds with power that it's trying to reach.
	-	-
Resistance *(Mx : 11-16)* *(dec.)*	***SET*** – Nonsense,	***APP*** – PWR24 responds with calculated resistances,
	APP – Master requests calculated resistances,	***APP*** – PWR24 responds with calculated resistances,
	EXP – Master requests calculated resistances.	***APP*** – PWR24 responds with calculated resistances.
	-	-
Vrms *(Mx : 10)* *(dec.)*	***SET*** – Nonsense,	***APP*** – PWR24 responds with calculated Vrms,
	APP – Master requests calculated Vrms,	***APP*** – PWR24 responds with calculated Vrms,
	EXP – Master requests calculated Vrms.	***APP*** – PWR24 responds with calculated Vrms.
	-	-
SrvVoltage *(Mx : 17-22)* *(dec.)*	***SET*** – Master sets new service voltages,	***APP*** – PWR24 responds with service voltages that it will use,
	APP – Master requests currently applied service voltages,	***APP*** – PWR24 responds with service voltages that it is currently using,
	EXP – Master requests currently applied service voltages.	***APP*** – PWR24 responds with service voltages that it is currently using.
	-	-
NominalPower *(Mx : 23-28)* *(dec.)*	***SET*** – Master sets new nominal powers,	***APP*** – PWR24 responds with nominal powers that it will use,
	APP – Master requests currently applied nominal powers,	***APP*** – PWR24 responds with nominal powers that it is currently using,
	EXP – Master requests currently applied nominal powers.	***APP*** – PWR24 responds with nominal powers that it is currently using.
	-	-

Signification for bits 1 and 2 in command byte :

SET : 00 -> Mode "**Set-New-Settings**",
APP : 10 -> Mode "**Request-Applied-Values**",
EXP : 11 -> Mode "**Request-Expected-Values**".